## Specifying information needs: Improving the working methodology

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# Specifying information needs: improving the working methodology

Jos G. Timmerman · Joop De Boer · Matthijs Hisschemöller · Wim Herbert Mulder

**Abstract** Specification of information needs is an important step in the design of monitoring networks. Within the framework of Monitoring Strategy 2000+, a programme of the Dutch Directorate General of Public Works and Water Management (Rijkswaterstaat) which seeks to provide innovation in the monitoring sector, a method has been developed to link water management policy to monitoring through specification of information needs. Over the past 2 years, this method has been applied in several projects within the Rijkswaterstaat organisation. Use of this method has led to improvements in the monitoring practice and was judged very positively by the people involved. Nevertheless, the main obstacle to employing the method was the actual translation of policy matters into information products. A special study is carried out, focusing on this aspect within the method, to provide the participants of a project with a mental framework that enables them to clearly specify their information needs. The major requirements for this mental framework are that all participants have a clear view of the process (system), and that they are able to relate their contribution to this process and to the contributions of others (transparency). The first step of the process is to focus the attention of stakeholders on the information they will actually need for decision-making. The next step is to confront the different expressed opinions through the method of the 'devil's advocate', which implies criticising the results of the first step by finding as many as possible arguments against these opinions. This should force the stakeholders to better specify their arguments. The method, its improvements and the results of one pilot project will be discussed in this paper.

**Keywords** Information needs · Problem structuring · Water management · Stakeholder involvement

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## Introduction

Policy-makers and water managers are overwhelmed with data and pieces of information that may or may not be of use to them. Ward and others (1986) have described this 'data-rich but information-poor syndrome', and more than a decade later, this 'syndrome' still exists. For instance, at the conference "Bridging the Gap" at the end of the 1990s, a conference on new needs and perspectives for environmental information, it was concluded that at present some of the systems for monitoring and gathering information about the environment in European countries are inefficient and wasteful. They generate excessive amounts of data on subjects that do not need it; and they fail to provide timely and relevant information on other subjects where there is an urgent policy need for better focused and consistent environmental assessment and reporting (Pentreath 1998). Within the Dutch Directorate General of Public Works and Water Management (Rijkswaterstaat), part of the Ministry of Transport, Public Works and Water Management, this problem was recognised and action has been taken to solve it. The adoption of the information cycle (Fig. 1) as a framework to describe the process of information production was a first step. The next step was the development of a method for the specification of information needs. This method is

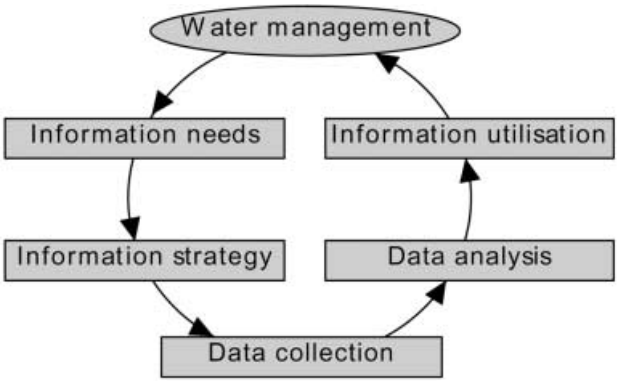


**Fig. 1**
The information cycle. (Adapted from Timmerman and Hendriksma 1997)

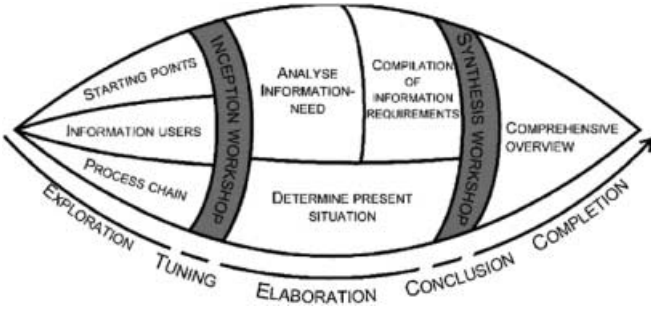


**Fig. 2**
The five-step method for specification of information needs (Timmerman and Mulder 1999)

represented as a 'rugby ball' (Fig. 2), symbolising the initial diverging character of the process that at a certain point should converge into a coherent plan. This representation proved to be a powerful tool in communicating the method. The method consists of a five-step plan, all steps being interrelated: (1) exploration, to mark out the project; (2) tuning, to communicate and verify the starting points; (3) elaboration, to come to detail; (4) conclusion, to communicate and verify the results; and (5) completion, to document the results and to plan subsequent steps. The method is further described in Timmerman and Mulder (1999).

Although the method provided a good basis for linking policy to information production, experience in using the method showed that the major obstacle was to define the information needs in such a way that a monitoring network could be defined from it. A project was started to improve the method in this respect. Four phases were identified for the project: (1) diagnosis of the bottlenecks within the method as used; (2) adaptation of the method to obtain a better result; (3) testing of the adapted method in two pilot projects; and (4) evaluation of the method and reporting. In this paper, the results of this project after the completion of a pilot exercise are presented and discussed.

## Diagnosis

To make a diagnosis of the weak points in the method, a number of people who had experience in applying the method were interviewed. From these interviews, three types of application situations were distinguished: relatively structured information problems, not very related to policy matters; relatively unstructured information problems in the context of ambitions to develop more integrated information systems; relatively unstructured information problems in the context of a pragmatic approach to information systems.

Application of the method in relatively structured information problems (with clear policy objectives and known relevant circumstances and useful parameters), such as information for operational water management, yielded little in the way of bottlenecks. In these cases, the method was focused on discussing the parameters. Information needs were not explicitly specified.

Application of the method in unstructured information problems revealed more shortcomings in the method. In these cases there was a need for more preliminary work, more assistance and a better perception of the start and end of the method. It appeared that in these cases the information has to serve several purposes, such as policy evaluation, policy analysis and related reports. The various objectives put different requirements on the information which hinders the adoption of an unambiguous perspective, like the question "What kind of decisions have to be taken on the basis of this information?". Further, no clear distinction was made between specification of information needs and specification of information strategies. This blurs the outcome of the method and has led to diverging results. Also in the projects, information users and information producers were not intended to have their own role as it was considered enough to improve the contacts between these groups, which normally do not run across each other. Consequently, the specific contribution of information users and information producers to answering the questions remained unused.

These observations may be seen against the background of the distinction between operational information and strategic information. Operational information is used for structured activities with a clear target while the relevant conditions and the actions to be performed are known. Information is needed to decide what action is necessary at what moment. An example of operational information is that which is needed to navigate, for instance signposts in a hospital or airport. Strategic information is needed when the tasks are not structured, like policy and management issues. Such issues have no clear structure because of the complexity of the targets, circumstances and possible actions. This is related to conflicting demands but also to different perceptions of the nature of the issue.

Strategic information should assist in structuring the issue and in clarifying what decisions should be taken. To deal with unstructured issues, strategic planning was developed in the 1970s. Strategic planning works systematically towards making the targets more explicit and exploring and

predicting the circumstances that influence the achievement of these targets, followed by evaluation of possible strategies. In practice, this approach has some disadvantages in which the following factors play a role (Mintzberg et al. 1998):

1. Formalised planning is based too much on abstracted and aggregated data.
2. Too little attention is paid to the strategic significance of concrete details and synthesis of findings.
3. Managers need alternative views on strategic possibilities, not uniform schemes.
4. 'Hard', factual data have limitations; on closer inspection they are not as 'hard' as they appear, they are often not available in time and do not cover all relevant aspects of the problem.

These disadvantages are partly in line with differences in styles of thinking (Hopstaken and Kranendonk 1991; Mintzberg et al. 1998):

Design:
Some people have a recording style of observation and are inclined to solve problems in an analytical way. They emphasise formal rules and explicit knowledge of the trouble-spot and formally record procedures in handbooks. Some characteristics are: a focus on quantifiable aspects; general design rules used to cope with change; the process of change is seen as a linear, finite and discontinuous process.

Development:
Others are more inclined to observe in a sensing way, relying on intuition and implicit knowledge of the trouble-spot, which has more context than words can express. Emphasis is concentrated on developing ideas. Much attention is given to social and political, usually qualitative aspects; the specific situation is taken as the starting point for change; and change is viewed as a cyclic, open-ended and continuous process.

Distinguishing between these styles of thinking is less important in operational matters, because the actions are known and it is only the information that determines the action to be taken. In strategic contexts, however, these styles can lead to quite different courses of action, while it is not possible to determine which is the better way. When strategic issues are at stake, the use of a method such as a general design rule with a composite quantitative score will appeal to 'design' people, but will prove unacceptable to 'development' people.

The 'rugby ball' method contains many aspects of the 'design' approach. Yet it is not meant to be an established route but rather to provide handles with which the process can be implemented. The method should provide a framework for stakeholders to give them insight into the process. Within this framework individual ideas can develop further. The issues we are facing in specifying information needs are not strictly operational or strategic but represent an intermediate position. In most cases, there is knowledge about the targets, relevant circumstances and possible measures as laid down in policy documents. The policy takes the form of an integrating decision model, integrating social and economic aspects, like the use of a water body, with targets for water quality and quantity. Decisions are based on balancing measures that may be needed at a certain moment. This integrating decision model, which might result in some kind of multicriteria or multi-attribute evaluation (e.g. Von Winterfeldt and Edwards 1986; Keeney 1992), is here the starting point in specifying information needs. The policy-maker must reflect on the fundamental objectives that are relevant for a water body and then think along two lines (Fig. 3). One line is making criteria for objectives operational. The other line is making an inventory of problems and related measures that may influence the reaching of the objectives. Along these lines, the policy-maker works towards specification of information that is needed to balance between future measures.

A number of items have to be accounted for when this integrating decision model is used for specifying information needs (Von Winterfeldt and Edwards 1986; Keeney 1992):

1. It is essential that all people involved are familiar with the terminology, as, for instance, for some a target may be just a direction and not something to actually reach.
2. Special attention is needed to specify the borders of the system in space and time.
3. When using the integrating decision model, the unruly reality must be described in an understandable and consistent way. This implies looking for compromises between different ways of partitioning and describing reality.

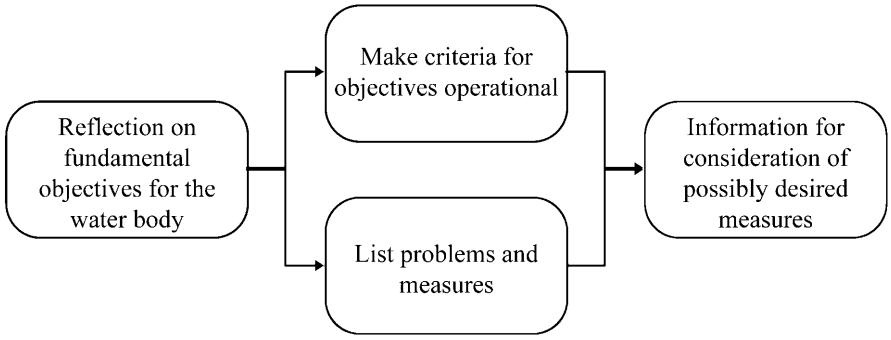


**Fig. 3**
The integrating decision model as a basic concept for specification of information needs

4. Usually, it is not possible to come to a complete elaboration of the decision model. Therefore, an iterative approach is needed to view the relation between the fundamental objectives and criteria both top-down (from abstract to concrete) and bottom-up (from concrete to abstract).

The pilot exercise interviews also highlighted some other relevant points:

1. The available knowledge about the various parts of the integrating decision-model is spread over different organisational units.
2. The organisational units are not constructed along the lines of fundamental policy objectives.
3. Little experience exists with the process of linking fundamental objectives to concrete criteria.
4. More knowledge is available on the physical, chemical and ecological aspects of the subjects than on the societal aspects.
5. The emphasis is not on decisions as such but on the design of a monitoring programme to support decisions.

Some of these points must be considered as part of the continuous problem of organisational decision-making. However, at other points improvement is possible to support policy-makers in specifying their information needs:

1. Make the underlying decision model more explicit.
2. Explain the most important concept and steps in the process of thinking.
3. Use working schemes that clarify the in-between steps of the process.
4. Aim at a result that is understandable and transferable.

From this diagnosis it was concluded that specification of information needs is best done by anticipating the decisions that have to be taken based on the information. The 'rugby ball' method as described is based on this assumption, but the relation to the decisions is rather implicit and is not worked out systematically. To support the method, working schemes are developed that can be used to clarify and direct the thinking process. A further distinction is made between operational and strategic information. In specifying information needs for operational use, the working schemes will easily be detailed. In specifying information needs for strategic purposes, the structure of objectives, aspects and criteria will require much elaboration.

## Adaptation of the method

In adapting the method, the keywords are *system* and *transparency*. All participants in a project must work according to the set plan (system) and must be able to relate their own contribution to the contributions of the other participants at any moment in the project (transparency). The proposed method comprises four steps, which will be discussed in this section: (1) preparation by initiators; (2) interviews for the preparation of a workshop; (3) the workshop; and (4) feedback to participants, aiming at initiating the next step: specification of the information strategy.

### Preparation by initiators

The attention of stakeholders should be focused on the decisions they have to take sooner or later, based on available information. Normally, everybody to some extent anticipates on having to make decisions; however, usually not very systematically. By working systematically, with the use of a few simple questions and schemes, a person can give an almost complete view of his/her information needs. The mind-steps to be followed are presented in Fig. 4.

The first question that the stakeholder should pose is: 'What are my fundamental objectives for the water body?'. Objectives should not be interpreted as assignments. The objective indicates what is considered to be important and

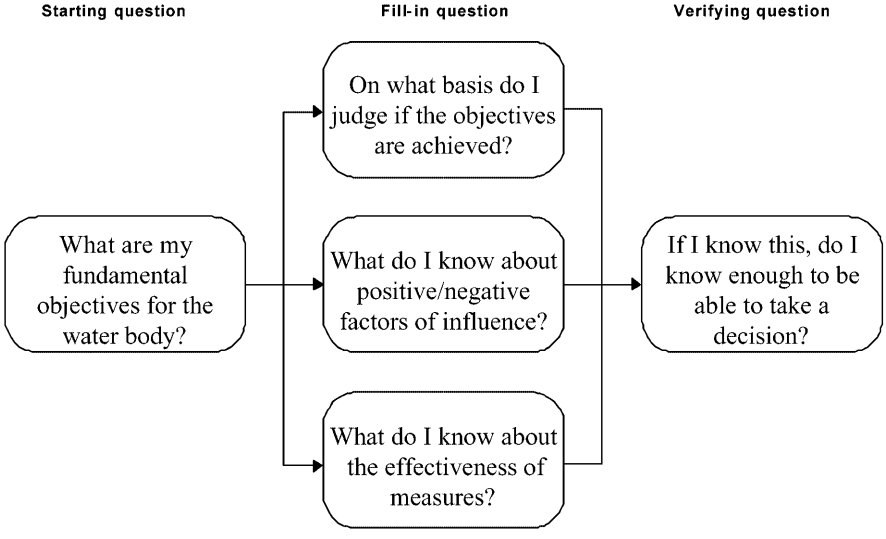


**Fig. 4**
Essential questions in the mind-model for the specification of information needs

this is generally matters that should be maximised (safety) or minimised (costs). After the starting question, three 'fill-in' questions are formulated. First, the stakeholder should speculate on: 'On what basis do I judge if the objectives are achieved?'. To find these criteria, it is useful to separate the important aspects from a general objective and then work out what measurable or easy perceptible criteria can be derived from this. This can be done on the basis of the scheme in Fig. 5. It should be noted that criteria should not be confused with means to reach a target. In fact, criteria are part of the fundamental objective. If a criterion changes towards the desired direction or reaches a desired level, part of the fundamental objective has been achieved. Keeney (1992) distinguishes between fundamental objectives and means objectives. The fundamental objective characterises an essential reason for interest in the decision situation. The means objectives are important because they are means to the achievement of the fundamental objective. As an example, an objective in water management may be to achieve high transparency of the water. This is a means objective, because it is of interest only because of its implications for the quality of the ecosystem. In Fig. 5, criteria are derived from fundamental objectives in a 'top-down' way. There is also the possibility to do this in reverse order. This implies that the stakeholder starts summing up the criteria he/she uses in daily practice and then asks himself/herself why; for what fundamental objective is this criterion important.

At the second fill-in question, the stakeholder ponders: 'What do I know about positive and negative factors that promote or hinder achieving the objective?'. This requires a different type of reasoning compared to the first question, as it now deals with indicating causal relations, making a distinction between cause and effect. There is the possibility that the stakeholder will put a fully developed causal diagram to paper, indicating how the objective is achieved. In practice it is more likely that he/she draws up a list of factors without all causal relations fully elaborated. On the basis of that list, he/she can indicate what he/she should know about the factors of influence to be able to account for them. Following from this, the third fill-in question is: 'What do I know about the effectiveness of measures that have to be taken if a negative influence occurs?'. This also requires reasoning in terms of relationships between targets and means (see the scheme in Fig. 6).

Based on the three fill-in questions, for each objective a working scheme can be produced in which the information needs are reported. Table 1 gives an example of such a working scheme. The information covers criteria, positive

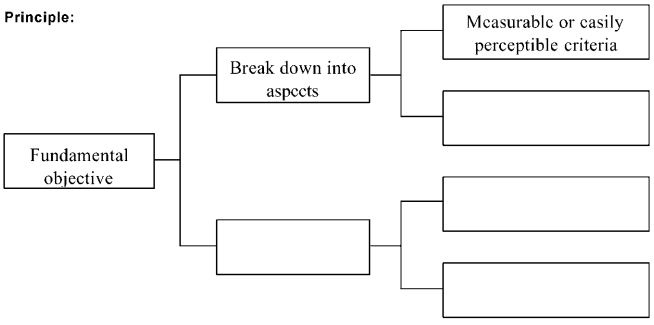


**Fig. 5**
Systematic breakdown of objectives; principle

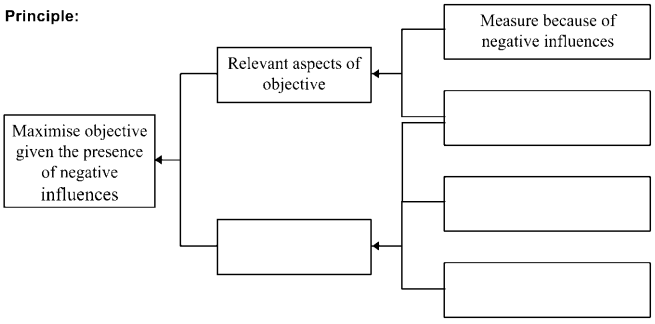


**Fig. 6**
Systematic breakdown of target and means; principle

**Table 1**
Working scheme for information needs; principle

| Matrix of information needs per objective | | | |
|---|---|---|---|
| **Criteria for the objective** | **Required data** | **Required processing** | **Further details** |
| | | | |
| | | | |
| **Positive/negative factors of influence** | | | |
| | | | |
| | | | |
| **Effectiveness of measures** | | | |
| | | | |
| | | | |

and negative factors of influence and the effectiveness of measures. The logical question that follows from this scheme is: 'If I have this information, do I know enough to be able to take a decision?'. Initially, a first draft of the working scheme in Table 1 is made up, based on general knowledge of the policy field. In the next steps, the scheme will be improved and expanded by the stakeholders.

#### Identification and selection of stakeholders

Stakeholders are selected to participate in the interviews and in the workshop. They can be identified through the next questions: (1) Who are (potential) users of information inside and outside the organisation? (2) Who are (potential) producers of information inside and outside the organisation? (3) To what extent are users and producers involved in policy-making?
Identification of stakeholders is followed by selection, based on the roles that the different actors play in the process. The final list of invitees for interviews and the workshop should balance (potential) users and producers together with other interest groups/individuals. It is important that the identification and selection of stakeholders is done in a systematic way and that how this is done is recorded, because (1) it clarifies the relationship between the content of the project and the process, and (2) it clarifies the opinions of the initiators about the various roles that the actors play in the process (for example user, producer, mediator).

#### Interviews for the preparation of a workshop

Interviews are a good means to complete the working scheme (Table 1) and to indicate the gaps. The synthesis of the individual interviews, containing an overview of information needs and gaps, is input to the workshop. When all interviewees have identified the same gaps, it is obvious that there is a common information need. When the same boxes in the working scheme are filled in differently by different interviewees, there is a need to further discuss the information needs or policy objectives.

#### Workshop

In the workshop, the working scheme, as drawn up on the basis of the interviews, should be discussed. Next, attempts should be made to fill in the gaps and make the information needs concrete for those boxes in the scheme where this is felt to be needed. It is very important that representatives of all the various sections are present in the process. In addition, a premature end of the process should be avoided, as there might be a tendency among the participants of the workshop to come to a quick agreement to be able to 'get back to work again' rapidly. This tendency is not necessarily advantageous because a full specification of information needs requires critical reflection. A dialogue sparked by conflicting opinions can be very productive to the achievement of a common goal. If consensus is reached at an early stage, this could be because differences of opinion are concealed instead of resolved. Therefore, the participants of the workshop should be stimulated to engage in constructive confrontation. One method to facilitate such a constructive confrontation is the 'devil's advocate' method.

##### The devil's advocate

This method is used to support strategic decision-making. The goal of the method is to test if the line of reasoning on which specific policies or strategic plans are founded contains inaccurate assumptions or inconsistencies. In practice, the method aims at making opinions as concrete as possible. Schwenk (1984) describes the approach as inviting some employees to voice strong criticism of the plan, by casting reasonable doubt on as many assumptions as possible. The authors of the plan can react on this, which then opens the discussion.

#### Feedback to participants

It is important that the workshop participants get feedback. So the outcomes of the workshop and a proposal for the next steps to implement the outcomes need to be communicated to them. Generally, the next step will be the translation of the information needs into an information strategy. This provides the participants with the opportunity to make corrections if needed.

## Pilot

The pilot at hand involved the setting up of a monitoring plan for the evaluation of restoration of saline gradients in estuaries. The Dutch water management policy is aiming to restore such transition zones, which should then lead to ecological benefits (Ministry of Transport, Public Works and Water Management 1999). The policy goal is formulated as: 'Gradual transition zones between water and land and between salt water and fresh water will be restored'. The first step in this project was to make an inventory of the existing policies and measures that were formulated. From this step it was concluded that the current policy lacked detail. The above-mentioned policy goal was chosen as input for the workshop. A provisional working scheme was set up. However, preparations for the workshop did not include interviews and completion of the working scheme. Workshop participants were stakeholders from different water management organisations and experts in the ecology field. In the workshop, each participant was asked to list the major aspects related to this goal. The resulting overall list could be clustered into three major groups: aspects of the ecosystem (changes in the ecological situation), aspects of the surrounding area (influence on agriculture, recreation, safety, etc.), and aspects of specific measures (specific restoration projects may aim at a particular goal). These clusters were discussed in three working groups to derive measurable criteria for each of them. It appeared that it is not easy to fit the results from the working groups into the proposed working scheme. This is partly due to the fact that the working scheme was not used as input to the workshop and that the participants were not familiar with the method. The organisers of the workshop were reluctant to apply the scheme in this case,

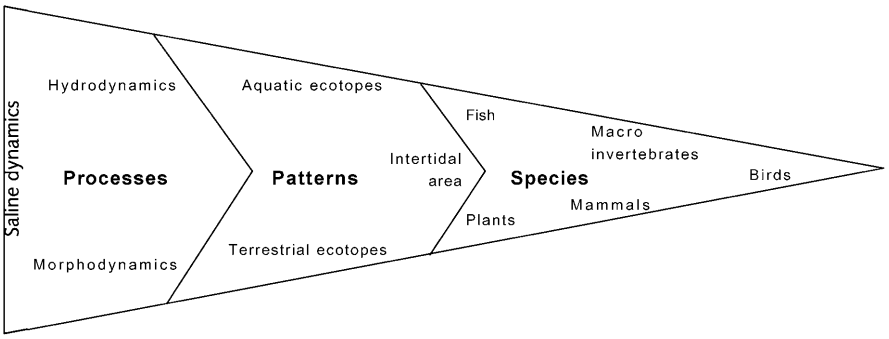


**Fig. 7**
Hierarchic connection between hydrological and morphological processes, patterns in ecotopes, and occurrence of species

due to the sensitivity of the issue of nature restoration in the Netherlands.
For this paper, an attempt is made to turn the outcome of the workshop into the working scheme of Table 1.

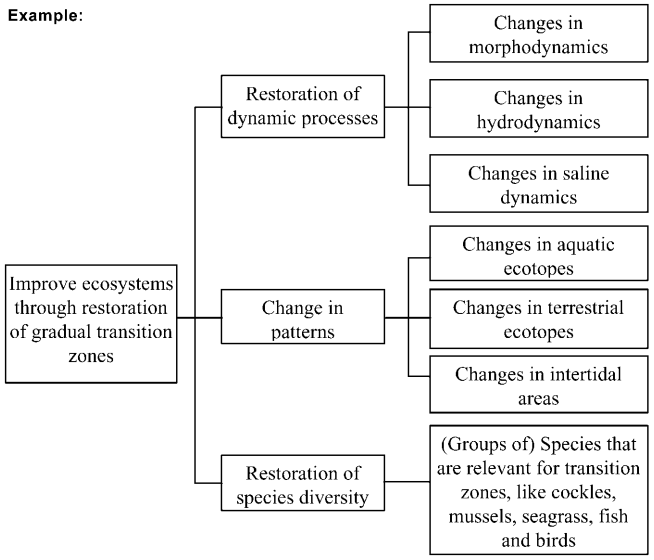


**Fig. 8**
Systematic breakdown of objectives; example

One conclusion from this exercise was that the three discerned aspects – aspects of the ecosystem, aspects of the surrounding area and aspects of specific measures – can be seen as the fundamental objective, factors of influence and effectiveness of measures, respectively.
Breakdown of the fundamental objective lead to the scheme shown in Fig. 7. This scheme represents the hierarchic connection between the various aspects discerned from the information about the ecosystem. Systematic breakdown of this fundamental objective in the proposed method leads to the next scheme (Fig. 8).
Deriving measurable criteria for the causal factors has led to a summation of various criteria. Figure 9 presents a systematic breakdown of targets and means for some of the criteria mentioned in the workshop.
For information on the effectiveness of measures, a series of possible measures was listed. For each measure, specific effects have been described. An example of a measure is the construction of fish passes. The expected effect would be an increase in fish migration. In Table 2, an example is provided of how the working scheme is constructed based on the objectives, effects and measures.
The importance of including aspects of the surrounding area came as a new result for the initiators of the project. The other outcomes of the workshop provided confirmation for the initiators that they were on the right track.

**Table 2**
Working scheme for information needs; example

| **Matrix of information needs per objective** | | | |
|---|---|---|---|
| **Criteria for the objective** | **Required data** | **Required processing** | **Further details** |
| Changes in morphodynamics | Areas of sedimentation and erosion per year | Use as input for dynamics model | Areas on a map |
| Changes in hydrodynamics | Tidal volume | | |
| Changes in saline dynamics | Chloride concentrations in surface water | | |
| Changes in aquatic ecotopes | Ecotope mapping | | |
| **Positive/negative factors of influence** | | | |
| Area with salt intrusion | Chloride concentrations in groundwater | | Salt intrusion map |
| Implement restoration measures such that the existing safety level is not decreased | Data on high water levels, storms, etc. | Model calculations of flood risks | |
| **Effectiveness of measures** | | | |
| Increase in fish migration | Diadromic fish species like eel and stickleback | | |

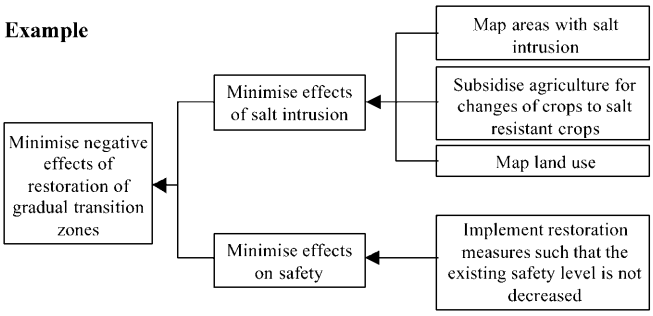


**Fig. 9**
Systematic breakdown of target and means; example

## Conclusions and recommendations

From the experiences in the pilot project and previous projects the following conclusions can be drawn:

1. The terminology used is important for the understanding of the initiators and participants. Use of the word 'aspects' in the context of 'the most important aspects for this objective' was confusing to many people. The question 'What do you think of when thinking about this objective?' provided more grip on the issue at hand. The same goes for the term 'measurable criterion'; when replaced with the question 'What do you need to know about this?', adequate answers were provided.
2. The systematic breakdown of objectives, targets and means provided much difficulty for the initiators. In a way, the scheme is limiting lines of thought. However, experiences in earlier projects show that, in the end, schemes can provide much insight, once formulated and accepted.
3. The method has been helpful in making the decision model more explicit. The importance of socio-economic aspects was initially underestimated by the initiators. The workshop brought this fact into the spotlight.
4. It is not easy to involve the actual decision-makers in the process. In most projects, the information users are represented by scientists that are involved in policy preparation.
5. It is important for the facilitator of the workshop to be acquainted with the subject, to be able to direct the discussion.
6. The devil's advocate method was not used in this pilot. Experiences from earlier projects, where this method was used in an incidental way by breaking down arguments in discussions to very basic assumptions, proved useful in forcing stakeholders to be more precise in their statements.

The adapted method clarifies the process to the participants. Nevertheless, application of the method is still difficult. To improve this, it is recommended that further adjustments to terminology are necessary. Further, it is recommended that the project is guided by a person who has experience in using the method. Finally, the method is not a template that only needs filling in, it is a framework that needs to be adapted to the situation at hand, thus emphasising the need to balance between the 'design' and 'development' lines of thought.

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